Volume 12 May, 1926 *Number 5*

Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Lubrication of Boiler Plant Machinery

Feed Water and Fuel Oil Pumps
Tube Cleaners
Coal and Ash Handling Equipment
Economizers
Blowers and Fans

PUBLISHED MONTHLY BY
THE TEXAS COMPANY, U.S.A.
TEXACO PETROLEUM PRODUCTS

Texaco Lubricants for Boiler Plant Machinery

FEED WATER AND FUEL OIL PUMPS

RECIPROCATING PUMPS

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[CONTINUED ON INSIDE BACK COVER]

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Lubrication of Boiler Plant Machinery

AS a sequel to the recent article dealing with the lubrication of mechanical coal burning equipment* it is fitting to discuss such other boiler plant apparatus which of necessity requires careful attention to lubrication if steam and fuel economies are to be continually attained.

Auxiliary equipment, such as feed water pumps, blowers, fans, fuel oil pumps, economizers, ash handling machinery and tube cleaners will frequently be more or less neglected. To an extent, this is often due to their location in relatively obscure parts of the plant. Then again, especially where solid fuels are being fired, and ash handling is necessary there will be a certain amount of dust and dirt present.

Conditions of this nature are very liable to foster an attitude on the part of operators that care in regard to the lubrication of the various bearings, steam cylinders, gears and chains involved will be wasted effort. Many, in fact, go so far as to regard lubrication of bearings, for example, as so vain an effort as to consider the cheapest kind of black oils good enough for the purpose.

To be sure, certain economizer bearings, pump guides, valve and link mechanisms, etc., will function on such lubricants, for they do lubricate to a certain extent. But this extent is not sufficient to insure continued operation with a minimum of power consumption. Ultimately scoring and abrasion of wearing surfaces will probably result, with overheating, abnormal consumption of steam or electric power, and probably the necessity in the end for rebabbitting or replacement of such parts.

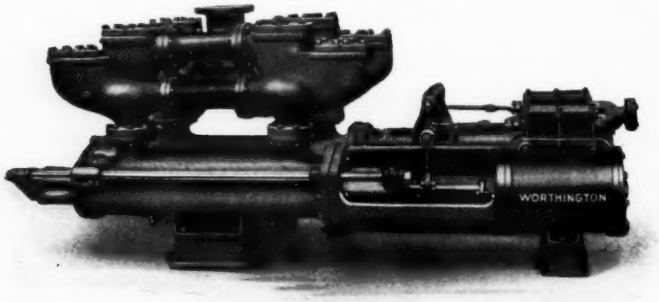
On the other hand, if we realize that boiler plant equipment is of quite as high grade a nature as any other machinery used elsewhere in the plant, we can readily appreciate that lubricants of equal quality should be used. The possibility of the presence of an abnormal amount of dust or dirt, or the chance of contamination with wash water when hosing is done carelessly is a most evident reason for protecting all wearing elements as far as possible with oils and greases of characteristics suited to the operating conditions. In the steam pump, for example, pressure, temperature and moisture are the factors involved. On an economizer scraper drive dust and heat must be counteracted, as is also true for ash handling equipment.

No one of these machines can very well be done without. The average plant, today, must turn out steam, so consistently and under such intensive demands that the least slip-up in any operating device might cause marked reduction in output, and increases in unit operating costs. It is not advisable, therefore, to increase the chance of failure or inefficient operation of any part of our boiler plant equipment by unwarranted neglect of lubrication; the ultimate saving in labor and cost of oil or grease is too insignificant in contrast with the potential power losses involved due to shut downs, or the overcoming of abnormal friction.

*LUBRICATION, March, 1926.

Feed Water and Fuel Oil Pumps

Boiler feed pumps and those devices which are essential in the delivery of fuel oil to oil burners will require our first attention from a lubricating point of view. For such service reciprocating and centrifugal or rotary pumps are extensively used.



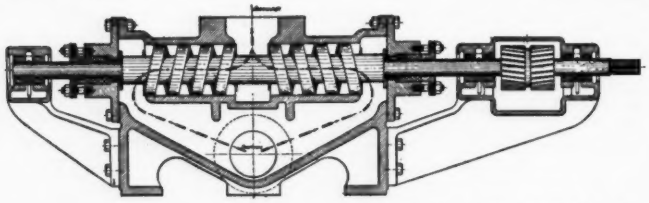
Courtesy of Worthington Pump and Machinery Corp.

Fig. 1—A horizontal, duplex, outside end packed pot valve type of boiler feed pressure pump.

RECIPROCATING PUMPS

Reciprocating pumps are extremely flexible in regard to speed, pumping capacity, and head. They furthermore show a relatively uniform efficiency curve under wide variations in the above conditions. They are therefore adapted for boiler feed and fuel oil service under all manner of operating conditions.

On the other hand with the exception of the triplex pump or others of more than two cylinders, there is very apt to be a certain amount of pulsation developed. In many cases this will not be objectionable, but where constant flow under uniform pressure is essential, as in the firing of fuel oil or the distribution of lubricating oil, it may easily be so detrimental as to materially reduce operating efficiency. Under such conditions, a type of geared, rotary or triplex pump would serve the purpose more effectively.



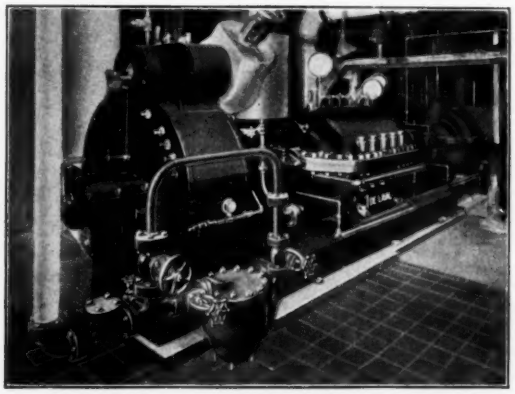
Courtesy of Wm. E. Quimby, Inc.

Fig. 2—Sectional view of a standard type screw pump. Note bearing brackets fastened to pump cylinder to decrease the possibility of misalignment. Bearings are ring-oiled.

The operation of reciprocating pumps involves sliding friction between the essential operating parts. Broadly speaking, these will include pistons or plungers, valves, piston rods, valve stems, and the various external mechanisms that are required according to the type of drive installed. Reciprocating pumps are either steam or motor driven. In the boiler plant where steam is involved, the drive is usually direct.

Electric drive reciprocating pumps, on the other hand usually require speed reduction mechanisms in the form of gears, chain belts or leather belts. With these latter, of course, we will also have to deal with rotary motion as involved in the bearings of motors, gear and sprocket shafts, eccentrics, connecting rods, etc., and also the combined rolling and sliding motion that will exist between the gear teeth in operation.

The direct-action duplex steam pump is one of the most commonly used devices in the boiler room. Of low initial cost, economical in maintenance, and with an ability to function dependably under more or less detrimental conditions, it has gained an enviable position in the eyes of those who must keep production moving. From a lubrication point of view it is generally a relatively simple piece of machinery to handle.



Courtesy of De Laval Steam Turbine Co.

Fig. 3—A turbine driven combined hot well and boiler feed pump. This pump is designed so that bearings and oil wells are far removed from the steam path, reducing the chance of over-heating to a marked degree.

Lubrication

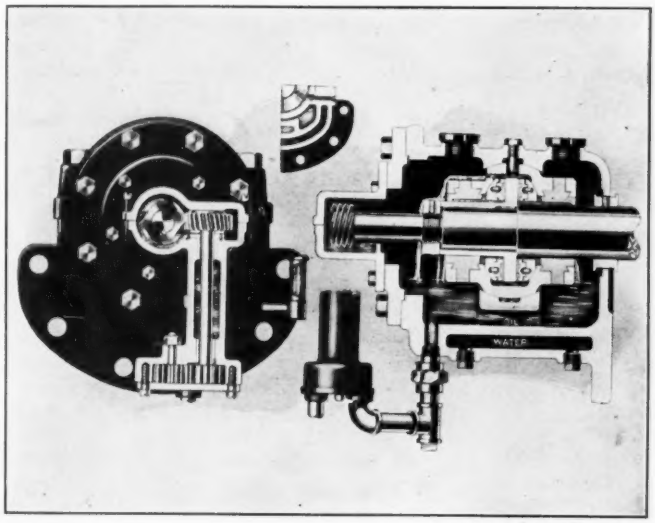
In lubricating reciprocating boiler feed and fuel oil pumps we will usually be confronted with the necessity for two basic types of lubricants, i. e., one to serve the internal parts such as steam cylinders and valves; the other to serve the external wearing

mechanisms such as rocker bearings, guides and rod connections.

For steam cylinder lubrication we can, as a general rule, regard the steam pressure as the salient factor, assuming 150 pounds pressure as the dividing line in the choice of oils. Saturated steam will predominate, so the discussion is based on this assumption.

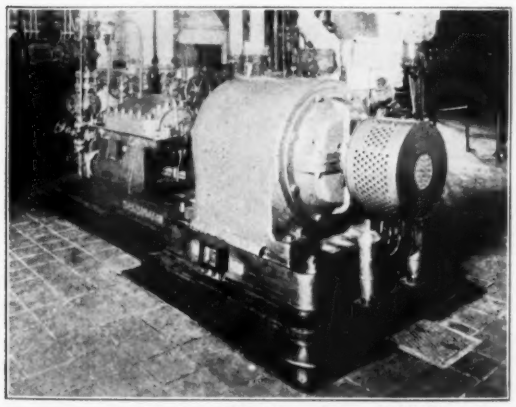
Above 150 pounds, for example, an oil of somewhat higher viscosity would be required than for lower pressure conditions. Too, a little less fixed or animal compound will be required due to the fact that there will probably be less moisture in the steam and less chance of washing action affecting the lubricating film once it is formed.

External bearing lubrication can be taken care of either by means of oil or grease according to the lubricating devices installed. In general plain babbitted bearings will predominate. Where oil is required a medium viscosity (300 to 400 seconds Saybolt at 100 degrees Fahr.) straight mineral product will generally be satisfactory. For grease lubrication a medium consistency cup grease will be best in compression grease cups or pressure gun systems, although a somewhat more fluid product may be necessary for pin type cups.



Courtesy of Ingersoll-Rand Co.

Fig. 5—Thrust bearing details on a multistage turbine driven centrifugal pump. Here oil is circulated by a geared pump as shown, to maintain a requisite lubricating film between the wearing elements.



Courtesy of Worthington Pump and Machinery Corp.

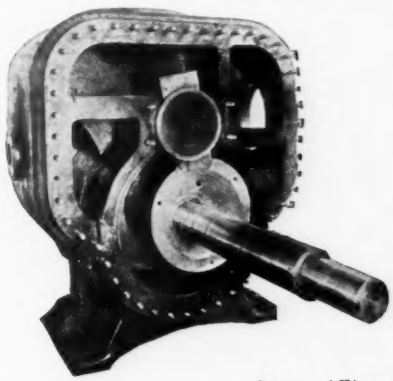
Fig. 4—An eight-stage centrifugal boiler feed pump, operating under steam pressures of 1,325 pounds gauge,—in reality one of the highest pressure plants in actual service to-day.

CENTRIFUGAL AND ROTARY PUMPS

Centrifugal Pumps

The centrifugal boiler feed pump in turn involves essentially one or more rotors or impellers revolving in a fixed plane within a suitable air tight casing. The liquid is received at the hub or centre of the impeller, pressure being acquired as it is impelled outward to the circumference, via suitable blades. Dependent on the type, fixed discharge valves are used similar to stationary nozzles, or a suitably designed spiral casing is employed for discharge purposes. Volute pumps are of this latter type.

In order for a centrifugal pump to attain maximum efficiency it must be free from air leaks not only in the suction but also in the pump; the discharge pipe must be of such a diameter as to insure the delivery of the liquid with a minimum of friction; the operating speed must be commensurate with the pumping head; and there should be a minimum of sharp bends and elbows in any piping involved.



Courtesy of Kinney Mfg. Co.

Fig. 6—Interior view of a rotating piston type of pump frequently used for the handling of fuel oils. To facilitate internal lubrication, holes are drilled through the pistons. There is practically no contact between the pistons and cylinders, and hence the minimum of wear results.

Rotary Pumps

Pumps with two rotating elements as frequently used for delivery of fuel oil, are commonly known as rotary devices, whether these elements are gears, screws, pistons, impellers, or cycloids.

Essentially the principle is that of the geared pump, the matter of teeth or lobes being the criterion.

Lubrication

While pumps of this character will involve but the lubrication of bearings, these latter may be of a number of designs, presenting specific problems according to the operating conditions. As a result they require careful consideration and can not be passed over as mere instances of ring oilers, ball bearings, etc., or plain babbitted bearings served by oil or grease cups.

For general all-round service on horizontal pumps the ring oiler is preferred by many builders due to its comparative simplicity, cleanliness, the extent to which it brings about automatic lubrication, the small amount of attention which it requires, its economy, and the uniformity and regularity of oil distribution.

Tube Cleaners

Dependent upon the hardness of the feed water used, boiler tubes, economizer, condenser or other tubular heating surfaces in contact with water will tend to accumulate more or less of a scale deposit on the water side, with a certain amount of soot on the fire or hot gas side. As a rule such deposits will be relatively hard, and will act as insulating mediums to considerably reduce the rate of heat transfer. In consequence they must be periodically removed.

Courtesy of The Lagonda Mfg. Co.

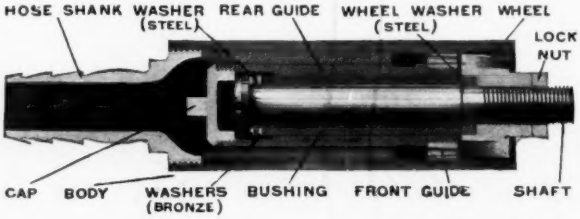
Fig. 7—A tube cleaner automatic lubricating device showing lubricator valves, air inlet, connections, and metallic hose which is inserted within the operating hose to deliver oil directly to the cleaner.

To most effectively accomplish this in a water tube, or return tubular type of boiler an economizer or a superheater, a tool known as a tube cleaner or turbine is generally used. This brings about scale removal from either side of the tube by means of cutting, or rapid and continuous vibration of a hammer or vibrator, the latter striking the tube at a frequency commensurate with the pressure. To most completely remove soot or scale, with a cleaner of this latter type, dependent on the type of boiler, or other heating element, it is important that the hammer strike against the bare or cleaned walls of the tube. Impact against scale or soot encrusted surfaces reduces the amount of vibration attainable to a considerable degree.

Typical Construction

Rotary or vibratory operation of a tube cleaner may be brought about by means of hydraulic, steam or air pressure. A rotor or water wheel, in the rotary or turbine type enables the direct pressure of water, steam or air to develop the necessary rotary motion at the cutting tool. In this type of tool, there may be one or more cutting elements according to the scale to be removed. Where two or more cutters are employed they are capable of free swinging, to take advantage of the effects of centrifugal force and insure as close contact as possible with the scale.

In the vibratory type of cleaner which chiefly employs air or steam pressure, the design is based on the principle of the reciprocating steam engine. In other words power is led to a preliminary air or steam chamber, to develop reciprocating motion in a suitable valve which in turn admits the air or steam alternately through opposite ports leading to a piston chamber, to act on a piston. This latter, being in contact with the freely moving vibrator which has its fulcrum at a point within the engine to the rear of the piston, is able to thereby develop the necessary vibratory motion in the hammer or vibrator.



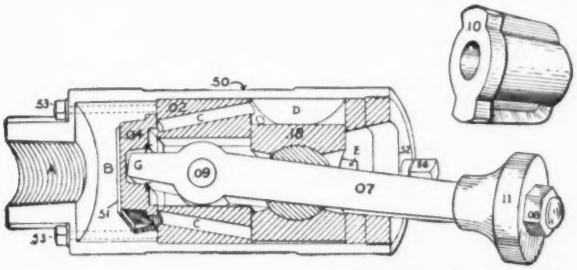
Courtesy of Liberty Mfg. Co.

Fig. 8—Sectional view of a cleaner motor or turbine. Rotary motion of the cleaning element is involved in this device. The cutting tool is fitted on to the shaft at the right.

Lubrication a Factor

As can be expected, tools of this character will require lubrication in order to minimize

the power-reducing and wearing effects of friction. In this connection the steam or air operated cleaner will require careful consideration. In the water or hydraulic power cleaner the turbine is water lubricated, the wearing elements being thereby effectively protected against frictional wear.



Courtesy of The Wm. B. Pierce Co.

Fig. 9—Section of a hammer type of cleaner. Power passes through nozzle "A" to chamber "B." As valve .04 is thrown back and forth the power is admitted alternately through ports "C" "C" to each end of the piston chamber "D," acting on piston .18 to give the vibrator or hammer its necessary motion. Exhaust passes out through "E."

The Vibratory Cleaner.

The wearing elements of the vibratory cleaner are perhaps somewhat more complex from the viewpoint of lubrication, than those of the rotary cleaner. With the exception of the ball and socket, however, as indicated by .18 in Figure 9, they will in general receive adequate lubrication if the steam or air is charged with sufficient oil.

The ball and socket, however, does not receive the necessary amount of oil from the intake or nozzle end of the cleaner. It must, therefore, be independently lubricated by means of an oil can, approximately a tablespoonful of oil being squirted in from the hammer end at ten minute intervals during operation. If this precaution is not taken the ball will tend to wear rapidly, in consequence striking against the socket at every stroke to cause further wear and ultimate breakage.

Other wearing parts, as mentioned, will receive adequate lubrication provided the air or steam is properly lubricated. To bring this about a suitable sight-feed lubricator is attached to the supply line. If such a lubricator is not used it will be necessary to oil by hand, applying about a tablespoonful every three to five minutes at the nozzle or intake end of the cleaner, according to whether compressed air or steam is being used.

Rotary or Turbine Cleaners

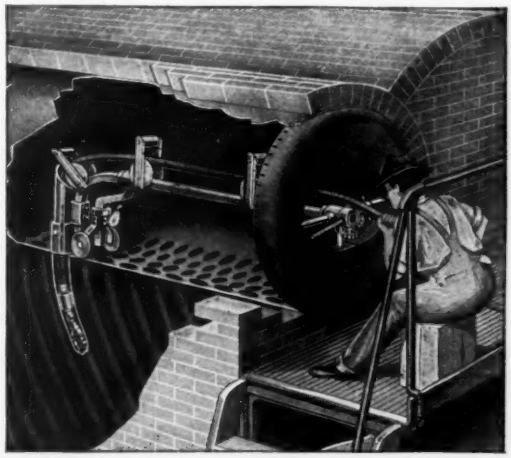
In tube cleaners of this type lubrication of motor or turbine bearings is essentially a problem of maintaining an adequate film of suitable oil between the rapidly rotating shaft of the rotor and its supporting bearings. Adequate impregnation or lubrication of the steam or air as it passes through the cleaner will bring about the desired results, just as mentioned above in the case of the vibratory cleaner.

A very effective method of not only delivering oil to the tool but also protecting the hose from deterioration (by preventing contact with oil), is shown in Figure 7. Here the oil line from the lubricator is run within the operating hose directly to the cleaner. When starting such a cleaner a small amount of oil should be poured in prior to connection to the operating hose, in order to insure lubrication of the bearings until the lubricator is functioning properly and delivering the necessary supply.

Oil to Use

In selecting oils for tube cleaner lubrication it will be necessary to consider whether air or steam is used as the motive power. A pneumatic cleaner will require a relatively light-bodied straight mineral oil, of approximately 200 seconds Saybolt viscosity at 100 degrees Fahr.

Where steam power is used it will be necessary to resort to a compounded steam cylinder oil. In practically every case the steam employed in such a device will contain more or less moisture. A certain amount of emulsifiable animal fat or fixed oil will, therefore, be necessary to give the requisite tenacity or adhesive ability to the oil film. The base of such an oil should be a steam refined cylinder stock, the



Courtesy of The Lagonda Mfg. Co.

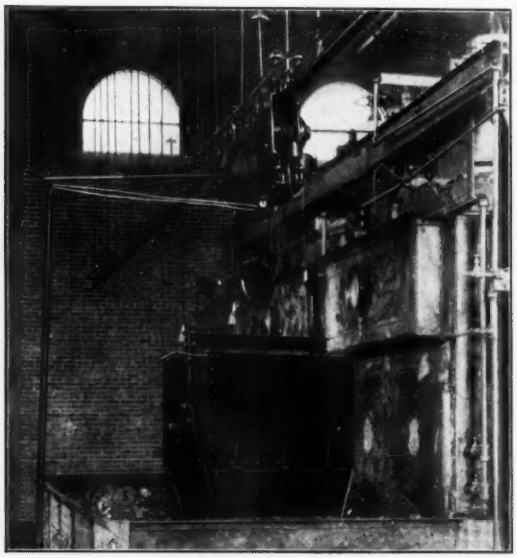
Fig. 10—A rotary tube cleaner in action in a stirling boiler. Note method of feeding cleaner in from without the drum.

viscosity of the ultimate product being in the neighborhood of 130 seconds Saybolt at 210 degrees Fahr.

Whatever the motive power or grade of oil required it is important to remember, in closing, that to effectively preserve tube cleaners and prevent rust, they should be immersed in oil when not in use.

Coal and Ash Handling Equipment

In the coal fired boiler plant the handling of fuel and ash will involve the use of more or less mechanical equipment, according to the volume of materials to be handled and the power developed. The extensive substitution of the mechanical stoker and powdered coal



Courtesy of The Cleveland Crane and Engineering Co.

Fig. 11—A tram-rail hoist and carrier for the handling of coal and ashes. Wearing elements of a tram-rail hoist in such service require careful attention to lubrication.

burner for the more laborious and wasteful methods of hand firing has led to the wide adoption of the overhead storage bin with its accessory coal chutes, hoppers, etc. All this has increased the amount of boiler plant equipment requiring lubrication and maintenance, but, in turn, it has decreased the labor of handling and reduced dirt and waste to a marked degree.

Lubrication of the stoker, the coal pulverizer, and of outdoor coal handling machinery have been treated in detail in recent issues of LUBRICATION.* Reference is, therefore, made to these articles, as a matter of interest. The present discussion will deal solely with such handling equipment as is located under cover and directly adjacent to the boilers. In consequence, it will cover tram-rail conveyors, etc., for handling coal and ashes; traveling weighing hoppers, ash hoppers and gates, and skip hoists for ash transfer to railroad cars, trucks, etc., for removal.

*December, 1925 and March, 1926.

Coal Handling

Coal handling in the medium and larger size plants, from the main storage yard or railroad to the boiler plant bunkers is very frequently accomplished by means of the skip hoist for elevating, with cars for horizontal distribution.

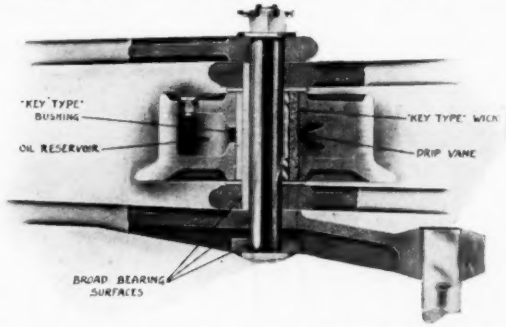
Essentially the skip hoist is a bucket designed to travel between proper guides, being hoisted from the loading pit to the discharge level above the storage bunker by means of cables and a suitable hoist. In the same form the skip hoist is used for handling ashes.

Tram-rail conveyors, and traveling weighing larries, which are also used for handling of coal within the boiler room, are very much alike to cranes in their design and method of operation. Like the skip hoist, they deliver the material handled at periodic intervals, a certain amount of time being necessary for charging, delivery, and return, of the empty carriers.

Bucket elevators are used for elevating, in the smaller plants, with screw or flight conveyors for horizontal distribution.

Lubrication a Factor

In the operation of any of the above equipment the essential points to guard against will be neglect, and disregard for the importance

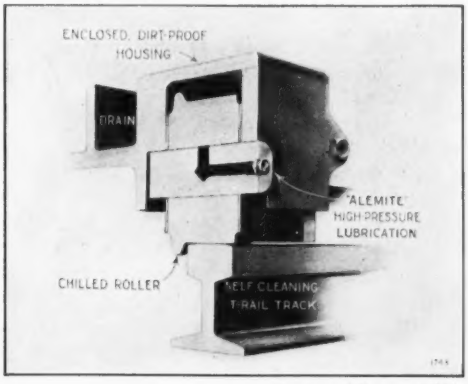


Courtesy of Link-Belt Co.

Fig. 12—Sectional view of a Peck carrier chain joint. Note details of the enclosed-oiling roller, with "key type" wick and bushing. This carrier is adaptable for handling of coal and ashes in the boiler plant.

of lubrication. As a rule, there will be a considerable amount of dust present, and, in many cases, the wearing elements will be exposed to a sufficient extent to permit of entry of enough abrasive foreign matter to cause considerable

wear. This will be especially true on certain apron, belt or chain conveyor roll bearings. For this reason some builders have made special effort to design their equipment of as nearly oil and dust-tight a nature as possible.



Courtesy of Beaumont Mfg. Co.

Fig. 13—Section of roller as used on a roller ash gate showing simplicity of axle and removable housing detail. Note that "Alemite" high pressure lubrication is employed.

Both grease and oil are acceptable lubricants, according to the design of such parts. The carrier roller, as shown in Fig. 12, for example, requires oil, a suitable wick being used as a distributor. In such a device a straight mineral oil of from 200 to 300 seconds Saybolt viscosity at 100 degrees Fahr. will be satisfactory. In general, such an oil will also be adaptable for the lubrication of the driving motor bearings of either ring oiled or anti-friction type, provided the housings will retain oil and temperature conditions are not abnormal.

Other types of conveyor rollers will be designed for grease lubrication, being equipped either with compression cups or pressure grease fittings. Unless the bearings of such rollers are relatively dust proof, grease will be the more satisfactory lubricant, for it will serve as an effective seal at the rims of the bearings to prevent entry of dirt or dust. The usual procedure in lubricating such rollers is to screw down the compression cup tops, or continue to force in grease with the pressure gun until there is a slight efflux at the edges of the bearings.

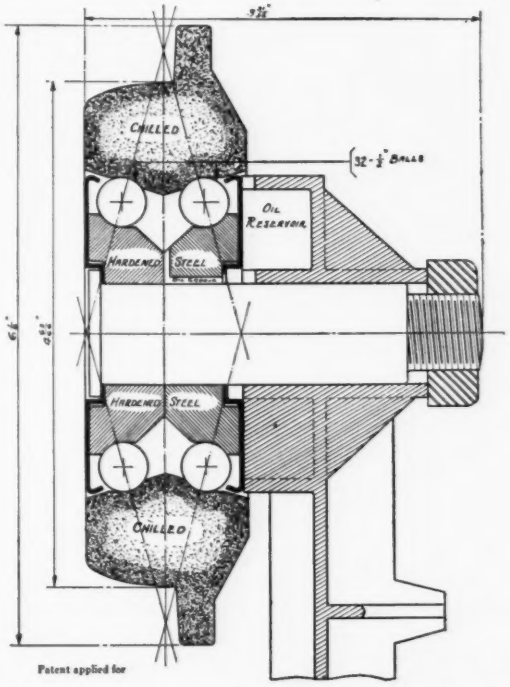
Under higher temperature conditions a relatively high melting point grease, as used on certain of the stoker bearings, should be used for this purpose. Normally, however, a medium bodied compression cup grease will give satisfactory results.

Wire Rope Lubrication

When the tram-rail or other modifications of the traveling crane are employed, or where skip hoists are involved, wire rope preservation and lubrication must also be given careful consideration. On the skip hoist, especially, will this be true, due to the possibility of exposure to the weather, and the subsequent occurrence of rusting and corrosion. Within the boiler plant, as for example in the case of a tram-rail and hoist installation, the presence of more or less dust and dirt will involve the most serious problem.

Wire rope lubrication in connection with the electric crane and other outdoor materials handling equipment was discussed in LUBRICATION for December, 1925. Where the conditions of operation would be more severe, in the case of such equipment, the points brought out will apply equally well to such wire rope as may be used in the boiler plant. Therefore, reference is made to this article.

In general a wire rope lubricant to be capable of effectively penetrating to the core and resaturating same, as well as serving as a protective medium against corrosion, should be a straight mineral product, of a viscosity of approximately 1000 seconds Saybolt at 210 degrees Fahr.



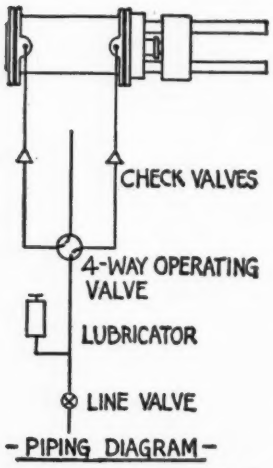
Courtesy of The Cleveland Crane & Eng. Co.

Fig. 14—Section of wheel and bearing of a tram-rail conveyor. Note ball bearings, the races ground on an angle, and the ample oil reservoir.

Ash Hoppers and Gates

Ashes can be variously handled by means of gravity, pneumatic pressure, traveling conveyors, larries, etc. In many plants gravity, by reason of economy of equipment involved, is

extensively used. The necessary chutes and hoppers are rugged, have no wearing elements, except the gates, and can frequently be readily located to discharge directly to carts, trucks, ash larries or railway cars.



Courtesy of Beaumont Mfg. Co.

Fig. 15—Piping diagram of oiling system for lubrication of steam and air cylinders as installed on a pivoted ash gate.

Conveyors have been discussed above. In principle and from the viewpoint of lubrication they are all very much alike, even though their layout and point of discharge may differ widely, according to the layout of the plant and the relative elevation of the boiler room floor, the ash pit and storage bins, the roadway or railroad siding.

Ash gates, however, will require individual discussion. They are subject to severe service, their wearing elements are close to the ash being handled, and they frequently are exposed to relatively high temperatures, especially if quenching has not been thorough.

In general they will be of the pivoted or roller type. While many pivot ash gate installations may be hand operated, power control by means of steam, air, hydraulic or oil pressure is advantageous for both types, especially in larger installations.

In the power operated gate steam or air cylinder lubrication is a factor, although if suitable lubricants are used there will be but little chance of difficulty or abnormal wear occurring. As a rule steam cylinder or air compressor cylinder oils as used elsewhere in the plant are quite adaptable to the cylinders of ash gate installations. Periodic application by means of a suitable mechanical force-feed lubricator or oil cup is all that is necessary, the amount of oil delivered to the steam or air per minute being approximately the same as that which would be fed to the cylinders of the average reciprocating steam engine or air compressor in the power plant.

Hydraulic installations, of course, require no provision for cylinder lubrication, water or oil serving this purpose admirably.

Pivot bearings which carry the pins in pivot type gates, and those of the rollers which support the gates in roller installations, are in general designed for grease lubrication. Pressures are relatively high, frequently there is considerable dust present, and temperatures may also be abnormal.

Pressure grease lubrication by means of a high grade, carefully compounded grease of medium consistency will effectively meet the above conditions. Grease is an especially advantageous lubricant where more or less of a seal is desired at exposed bearing ends, inasmuch as it prevents dust or other abrasive foreign matter from penetrating to the clearance spaces.

The Economizer

In modern boiler plant operation the economizer constitutes essentially one of the most important factors in the attainment of required boiler efficiency. The natural tendency of the operator is to falsely regard his economizer as relatively unimportant, due chiefly to its location and the fact that it usually seems to function in a satisfactory manner regardless of the attention it receives.

It is with the so-called scraper type of economizer that we are chiefly concerned in this discussion of lubrication.

Care and upkeep of economizer equipment develops into a relatively small matter provided lubrication of the component parts is properly attended to; on the other hand, neglect or careless selection and use of lubricants may result in serious troubles which will materially affect plant efficiency and fuel economy if the economizer must be cut out of service.

Principle Involved

In principle the economizer is based on the utilization of otherwise waste heat, generally by the application of the "counter-current" idea, using the heat contained in the flue gases after they have left the boiler, to heat the feed water to a more or less extent prior to its entering the boiler. Thereby the boiler gets but little of the sudden expansion and contraction due to change of temperature as would otherwise occur when colder water is fed. Thus many leaks are avoided and the life of the boiler is prolonged.

Design and Location

As generally constructed the economizer consists of a nest of tubes built into top and bottom headers, similar to a vertical water tube boiler. The feed water is circulated within these tubes.

The location of an economizer for proper results is between the boiler and stack, installed in the flue or uptake. Thus the waste gases, as they leave the boiler, pass around and between the tubes on their way to the stack, giving up considerable of their heat in passage to the water within tubes.

In certain types of economizers the exterior of each tube is kept free from soot deposit which is a non-conductor of heat, by scrapers which travel continuously up and down the tubes at slow speed, driven by a suitable mechanism. This scraper driving mechanism is the so-called heart of the installation. On its efficiency of operation depends the efficiency of the particular economizer and the benefits to be derived in the form of reduced heat losses.

Effect of Neglect

Neglect of lubrication of economizer motors, driving gearing, reversing mechanism, chains, shaft bearings, etc., will therefore be productive of serious consequences. Probably the results would be the ultimate burning out of the motor, shaft or engine bearings or production of such excessive wear of the gears and driving chains, that slipping or breaking might occur.

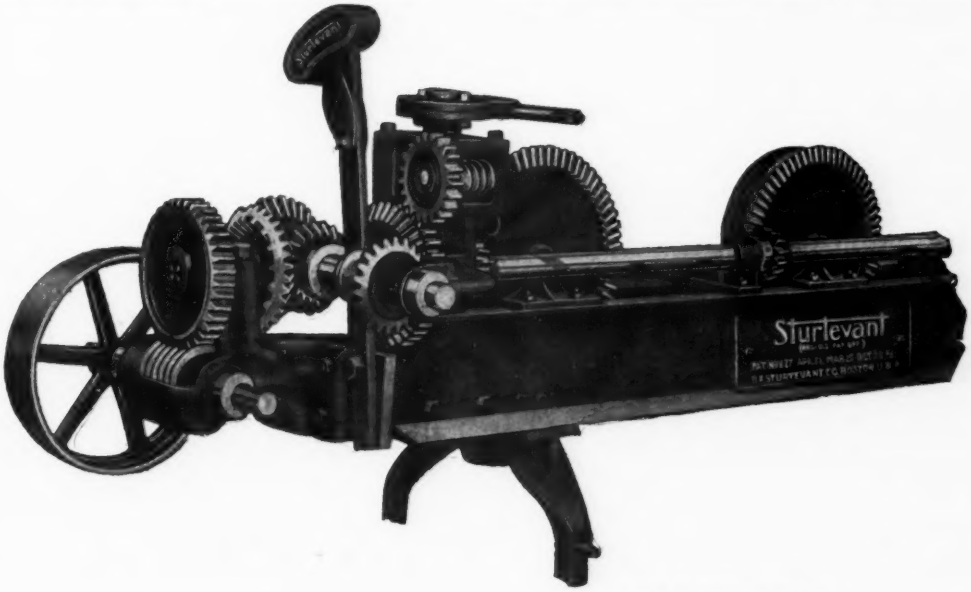
Lubricants Required

Electric Motors

Relative to the grades of lubricants required for economizer operation, it is safe to say that usually three or four will cover the conditions. Lubrication of motor bearings is similar to usual practice for such equipment in general. This has been extensively discussed for all types of bearings in LUBRICATION for October, 1925.

For ring oiled bearings a medium viscosity, straight mineral oil of from 180 to 300 seconds Saybolt at 100 degrees F. will meet normal operating conditions. Under excessively high temperature, however, it might be necessary to use a somewhat heavier oil.

Where ball or roller bearings are involved either oil or grease can be used, according to constructional conditions. Oil should be employed wherever it can be successfully retained in the bearing and housing. Frequently, however, there will be a possibility of oil leakage, or dust, dirt and water conditions will be so serious as to render grease lubrication advisable.



Courtesy of B. F. Sturtevant Co. Inc.

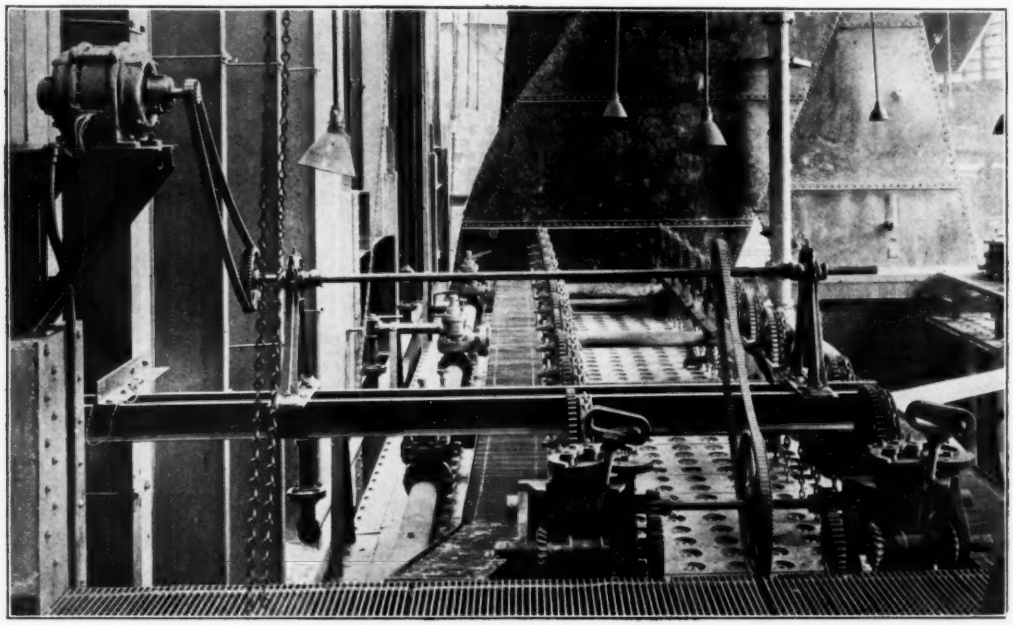
Fig. 16—An economizer scraper operating gear of the belt driven type. On exposed wearing elements of this nature considerable care must be given to lubrication.

SCRAPER DRIVE LUBRICATION

The lubrication requirements of economizers are confined solely to the scraper driving mechanism, and to the mechanical draft fan and engine if such are installed. They are not unique, nor do they involve details beyond the ability of the average boiler plant operator to handle. The problem is simply a matter of common sense, and appreciation of the fact that lubrication of all moving parts must be maintained, and inspection made frequently and periodically. The high temperatures usually prevalent in economizer housings, and the fact that the lubricants in service are continually exposed to these temperatures as well as to dust, dirt, and possibly atmospheric conditions, cause lubricating qualities to naturally deteriorate more rapidly than usual.

In general, oils for such bearings should be light, commensurate of course with the pressures and temperatures involved. Usually a viscosity of from 100 to 200 seconds Saybolt at 100 degrees F. will be satisfactory, the oil of course being a straight mineral product of high refinement.

The level of the oil in such a bearing is important. The fact that the oil serves more as a metal protecting medium, playing no part as a coolant, as in a ring or chain oiled bearing, renders volume more of a detriment than an asset. In general submergence of approximately one-half to three-quarters of the lowermost rolling element will be sufficient.



Courtesy of The Green Fuel Economizer Co.

Fig. 17—Top view of an economizer installation showing silent chain drives, electric motor, and reversing mechanisms. Surroundings detrimental to efficient lubrication are evident, due to excessive heat, dust, etc.

Grease, in turn, is advantageous in that it will not leak out where oil might, and that it furnishes an effective seal to prevent entry of dust, dirt or water to the bearings. To serve this purpose, under average temperature conditions, greases which are relatively fluid in consistency will afford both the proper lubrication and protection with a minimum of channelling and development of heat due to internal friction. Higher temperatures, however, in enclosed economizer housings may require the use of a somewhat more inert grease for motor bearings of this type.

Gearing

Reversing mechanism gearing, including worm, bevel and chain driving gears as the construction may include, under ordinary conditions will require a relatively stiff bodied lubricant which will spread evenly and stick tenaciously to the wearing surfaces, links and teeth. It should not be so thick as to form in clots where applied, and thus cover but parts of the wearing surfaces, to be thrown off by centrifugal force during operation. On the other hand it should be viscous enough to insure against loss from dripping. As a rule a straight mineral lubricant of from 1000 to 2000 seconds Saybolt at 210 degrees F. will meet these requirements.

Chain Sheaves

Bearings of chain sheaves can be lubricated by grease cups or simply oiled by hand, whichever the installation is designed for. Such bearings are relatively small, as a rule built with no mechanical means of lubrication, and subject only to very slow shaft speeds. Grease for such lubrication need not possess a high melting point, for though the temperature may rise to perhaps 150 degrees in an enclosed housing, it will never be so great as to liquefy an ordinary cup grease excessively. When the apparatus is built for hand oiling the lubricant can be the same as used on the motor bearings.

Reversing lever fulcrum and other miscellaneous bearings for driving shafts, etc., can be similarly lubricated by hand periodically at each inspection by the operator.

Scraper Mechanism

Typical constructions may differ somewhat in regard to the manner of driving the scraper mechanism. Belt drives usually involve fewer

complications than do chain drives from a single motor, especially where considerable shafting and individual chain drives therefrom are concerned.

Fans and Driving Engines

Where the installation is designed for forced or induced draft, the lubrication of the draft fan and its driving engine will also require consideration. Fan bearings in such installations are frequently water cooled and lubrication of same develops no special difficulties beyond the possible transmission of considerable heat via the motor. To meet this condition the lubricant should be fairly heavy in body, i. e., having about 500 seconds Saybolt Viscosity at 100 degrees F. Such bearings are usually of the ring or chain oiled type.

The driving engine for the fan is generally a simple steam driven, single cylinder, horizontal reciprocating engine. Normally it will be subject to the same temperature conditions as the other mechanisms considered heretofore.

Lubrication of engine cylinders, and valves, will usually be a problem of dealing with wet steam of perhaps 1% to 2% quality. In such a case the lubricant to use should be a cylinder oil compounded with sufficient fixed or fatty oil to effectually produce the required emulsion and stickiness in the oil when in contact with wet steam.

Lubrication of the other engine mechanisms such as crankpin, wristpin, crosshead guides, etc., can be best carried out by using a straight mineral oil of about 300 seconds viscosity. The same oil as used for ring-oiled motor bearings, etc., will usually meet the requirements very satisfactorily.

Vertical steam engines for draft fan drive involve no particular lubricating peculiarities other than stated for horizontal engines, and the lubricants to use for each part would be the same.

Engine lubricants are usually applied by means of hydrostatic steam cylinder lubricators attached to the steam pipe; and sight feed oil cups, or grease appliances attached to pin bearings and guides.

Where the draft fan is driven by motor the lubrication factor becomes simply that of using the proper lubricant in the oil wells or housings of the motor bearings. The condition will be very similar to those under which the scraper driving motor operates. Hence the same oil can be used satisfactorily, unless anti-friction bearings requiring grease lubrication are involved.

Blowers and Fans

Lubrication of blowers and fans is essentially a matter of serving their bearings with the proper grades of oil or grease according to their design and the provisions for supplying the lubricants. In general such equipment will be fitted with ring oilers or anti-friction bearings. As a result their lubrication will be essentially akin to that of centrifugal or rotary pump bearings, or those of the electric motor which may be of the same nature. To appreciate their lubricating requirements a brief insight into their construction, etc., will be of interest.

Ring Oilers

The ring oiler comprises a bearing housing which is built with a reservoir and a slot of sufficient width and depth to permit one or more rings suspended from the shaft to revolve therein. As a result, with the revolution of the shaft, these rings being subjected to rotation, will carry a certain amount of oil to the top of the shaft from whence it is able to flow into the bearing oil grooves and clearance space to be ultimately distributed to the entire wearing surfaces.

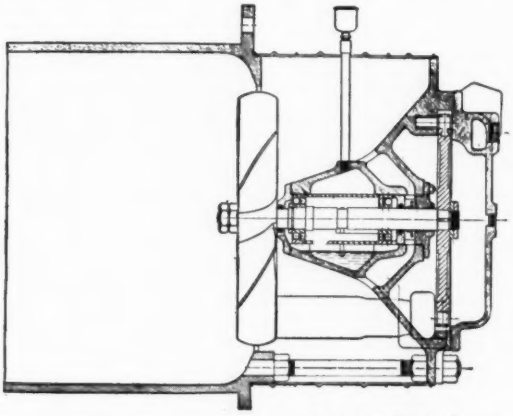
As a rule, the oil after being passed through the bearing, will flow out to the end or ends of the shaft through a suitable return chamber which is part of the bearing housing, back to the oil reservoir below. Ring oilers, however, are not usually recommended for bearings below two inches in diameter, especially where high speeds are involved, due to occurrence of excessive slippage of the rings, and the possibility of foaming arising in the oil where reservoir capacities are limited.

Courtesy of Clarage Fan Co.

Fig. 18—An oiling device for use on fan bearings. This provides for filling of a bearing to the proper level from an accessible position without. Note the sight glass for determining the oil level, and the drain plug below.

Ring oiling affords a most efficient method of lubrication whereby the bearings are flooded with a considerable excess of oil over the amount that would theoretically be necessary to furnish the requisite oil film. By flooding the bearing with oil, the latter serves not only as a lubricant, but also as a cooling medium to carry

away part of the frictional heat developed, thereby reducing the temperature of operation. If the oil reservoir in the base of the bearing has been properly designed and is of sufficient capacity, this overheated oil will have ample



Courtesy of Buffalo Forge Co.

Fig. 19—Sectional view of a turbo undergrate blower. Note the large oil reservoir, the ball bearings and length of sleeve or housing.

opportunity to become sufficiently cooled after each circulation by contact with the reservoir walls, particularly if the radiation of the latter is not interfered with.

Lubricating systems of this nature possess natural advantages in that the flood of oil which is constantly passing through the bearings, tends to wash out any grit, dirt, dust or metallic particles that may have gained entry, as a result, reducing wear to a minimum. On account of this washing action of the oil, however, the reservoir will gradually tend to accumulate a certain amount of sedimentary deposits. Therefore, it should be flushed out and cleaned at periodic intervals, the old oil being replaced with new or purified oil.

Anti-Friction Bearings

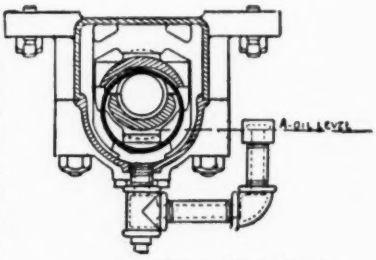
Where ball or roller bearings serve to support the journals of fans, rotors or impellers, the matter of flood lubrication is eliminated. Prevention of corrosion in such bearings, is regarded by many as perhaps the chief function of the lubricant, rather than actual reduction of friction or removal of heat.

Ball or roller bearings are advantageous in that they supplant sliding motion with rolling motion, thereby theoretically reducing the resultant friction where properly lubricated. Ball bearings involve point contact, whereas roller bearings involve line contact.

Wherever possible the housings should be oil-tight for thereby can we reduce the viscosity of the lubricant and in consequence the internal friction that will be developed during operation. Usually an oil of a viscosity in the neighborhood of 100 seconds Saybolt at 100 degrees Fahr., will give the best results under such conditions.

Where leakage is possible, however, a grade of semi-fluid grease should be used which will have just enough body to cause it to remain in the bearing housing. To lubricate such bearings, it is customary to charge or fill the housing and raceways with the proper grade of lubricant, through a suitable fitting or hole which can be effectively sealed or plugged during subsequent operation to prevent the lubricant from flowing out. In general one charge of oil in a roller or ball bearing equipped with an oil-tight housing should last for a period of several months. Where grease is required, however, it should be renewed more frequently, according to the extent of seal which is maintained, etc.

All fans and blowers, however, will not require or be equipped with ring oilers or anti-friction bearings. In certain cases grease cups, pressure gun fittings or sight feed oiling devices may be regarded as suitable by the builders, especially where operation is to be more or less intermittent. For such service a medium bodied engine oil or a plastic grade of compression cup grease will in general be found satisfactory and economical.



Courtesy of Clarage Fan Co.

Fig. 20—Details of a ring-oiled fan bearing showing oil filler and level control.

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Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

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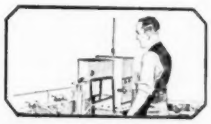

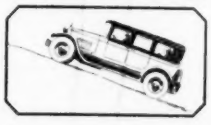

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